Dynamic analysis of shell structures containing kinks using an isogeometric Kirchhoff-Love formulation

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ABSTRACT

This work presents a NURBS-based isogeometric thin shell implementation for performing steady-state dynamic analysis of structures consisting of multiple shells connected via kinks. Kirchhoff-Love shell theory requires at least C^1-continuity. This is hard to accomplish using conventional finite elements, but easily obtained when using NURBS basis functions in an isogeometric context, which allows for modeling these shells without rotational degrees of freedom. Nonetheless, the connection of multiple NURBS-patches requires additional treatment because of the C^0-continuity across the interface between patches. This is resolved by imposing that both the deflection and the derivative of the deflection normal to the patch interface must be continuous across the interface. These constraints result in an additional set of linear equations which enforces the angle between the patches to be preserved. That way, the kink connection is straightforwardly prevented from acting as a hinge.

The good performance of the proposed method is illustrated using a numerical benchmarking example. The efficiency of the method and its accuracy for higher frequencies of analysis are found to compare favorably to a conventional finite element implementation of the Kirchhoff-Love shell.